Magnetic Untwisting in Most Solar X-Ray Jets

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Main Points

- **Hinode/XRT movies show:**
  ~50% of X-ray jets are standard jets, and ~50% are blowout jets.
- **SDO/AIA He II 304 Å movies confirm:**
  - **Standard X-ray jets don't expand laterally because they are made by interchange reconnection.**
  - **Blowout X-ray jets do expand laterally because they are made by blowout filament eruptions.**
- **SDO/AIA He II 304 Å movies reveal:**
  X-ray jets spin and sway.
- **Type-II Spicules are like X-ray jets in having:**
  - **Sideways-expansion dichotomy.**
  - **Spin and sway.**
- **We infer that Type-II spicules are:**
  - **Small analogs of X-ray jets.**
  - **Erupt from the granule-size emerging bipoles discovered by Hinode /SP.**
  - **Numerous enough to power the global corona and solar wind.**

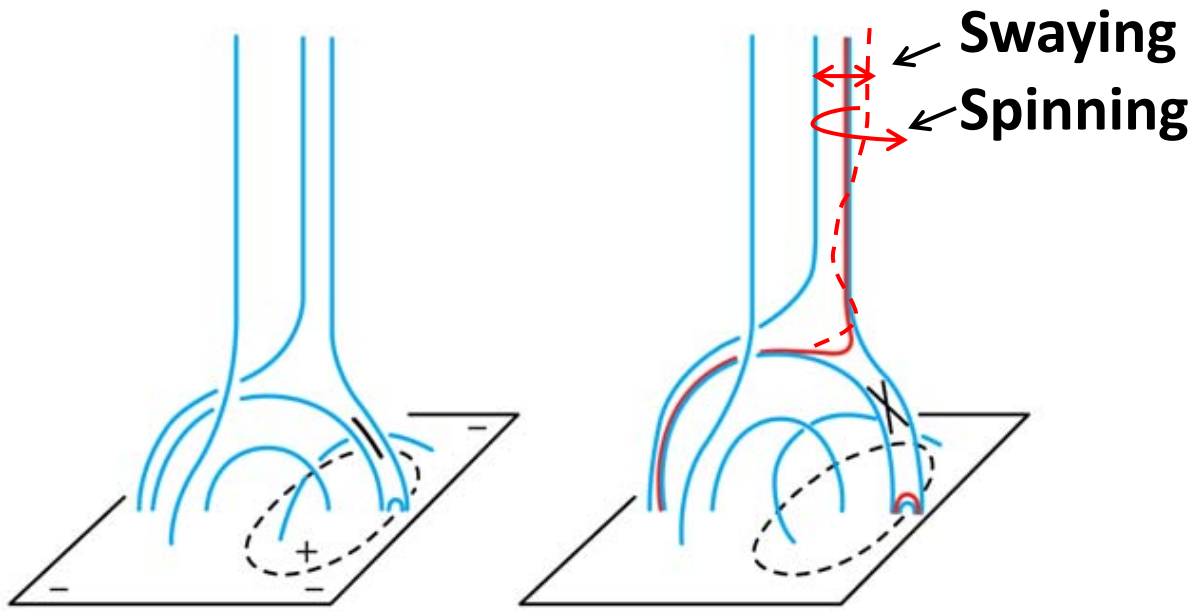
Outline

I. Introduction

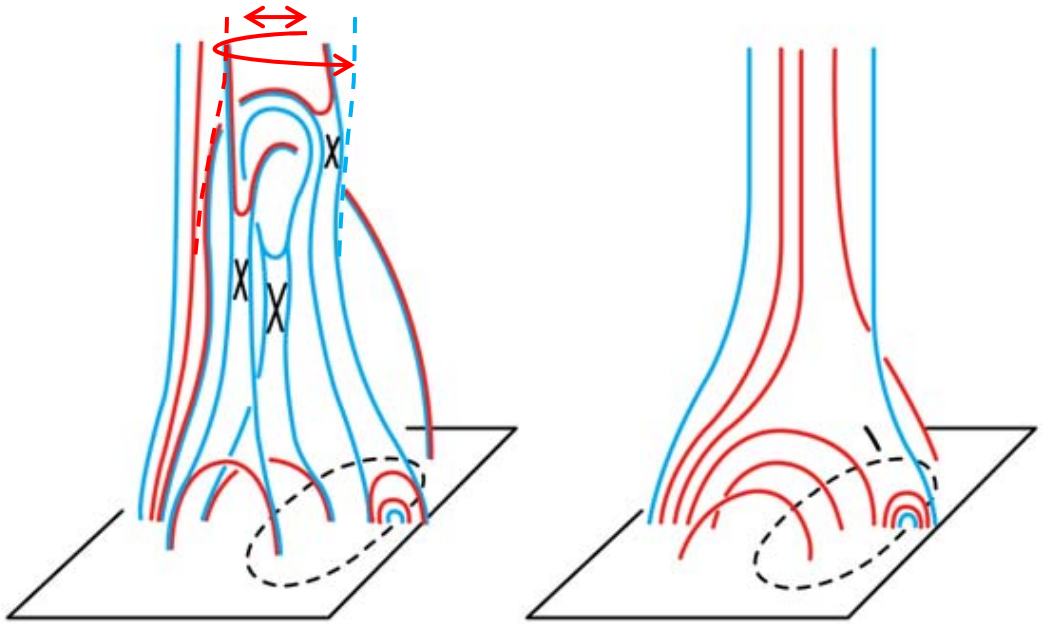
II. X-Ray Jets

III. Type-II Spicules and Coronal Heating

Standard Jet:

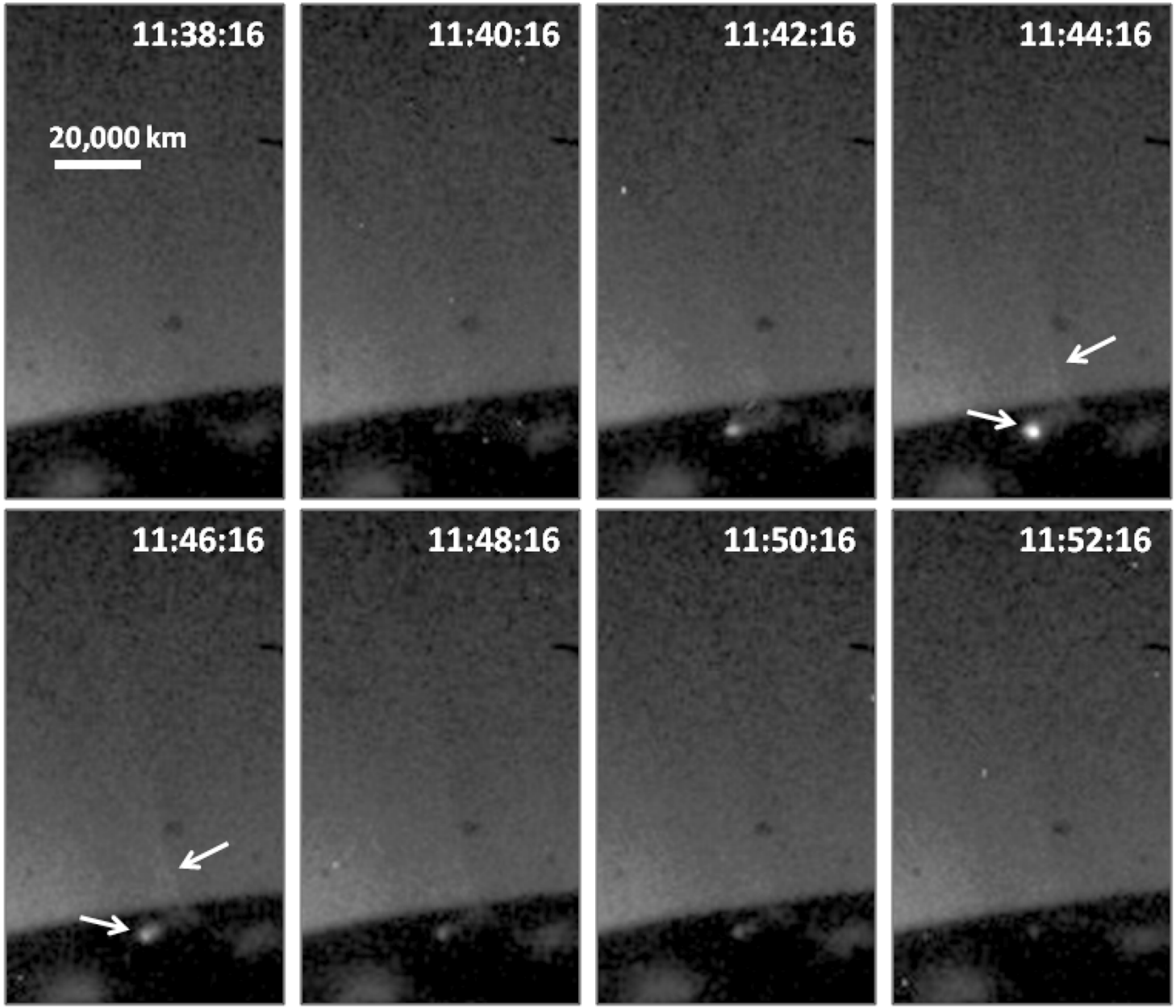


Blowout Jet:



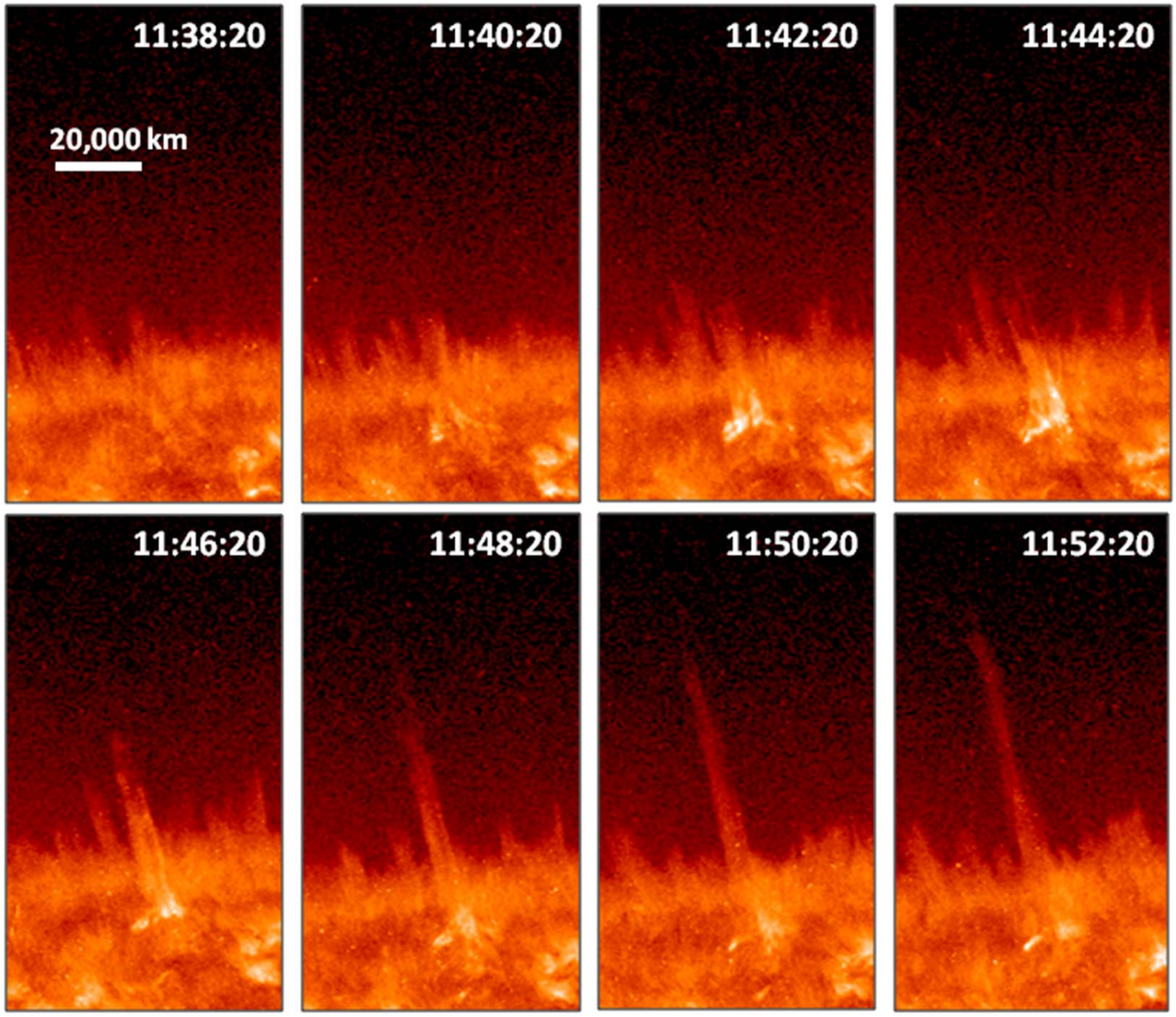
Example Standard X-Ray Jet

2010 Aug 28, Hinode/XRT Ti Poly



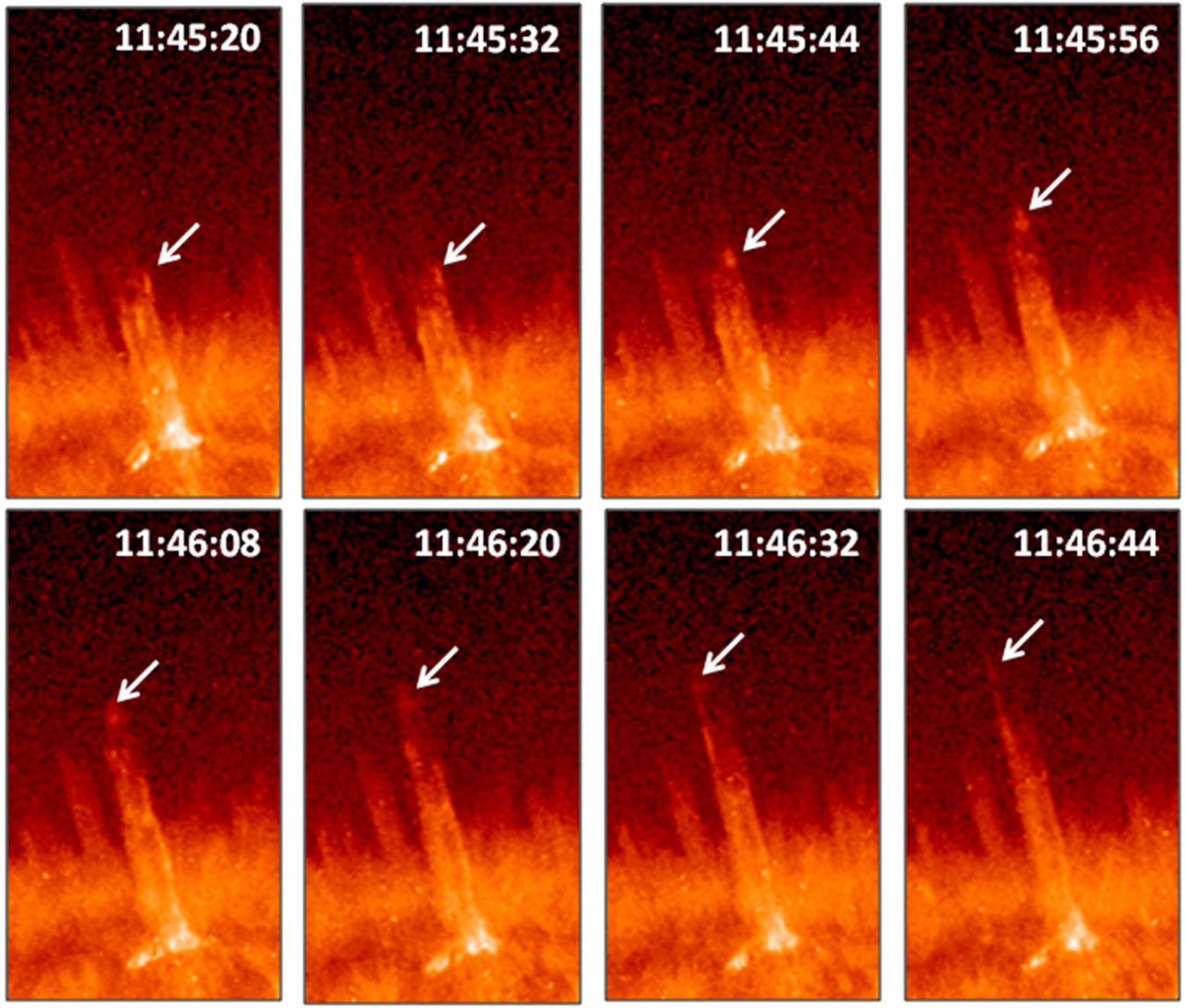
Cool Component of Example Standard X-Ray Jet

2010 Aug 28, SDO/AIA He II 304 Å



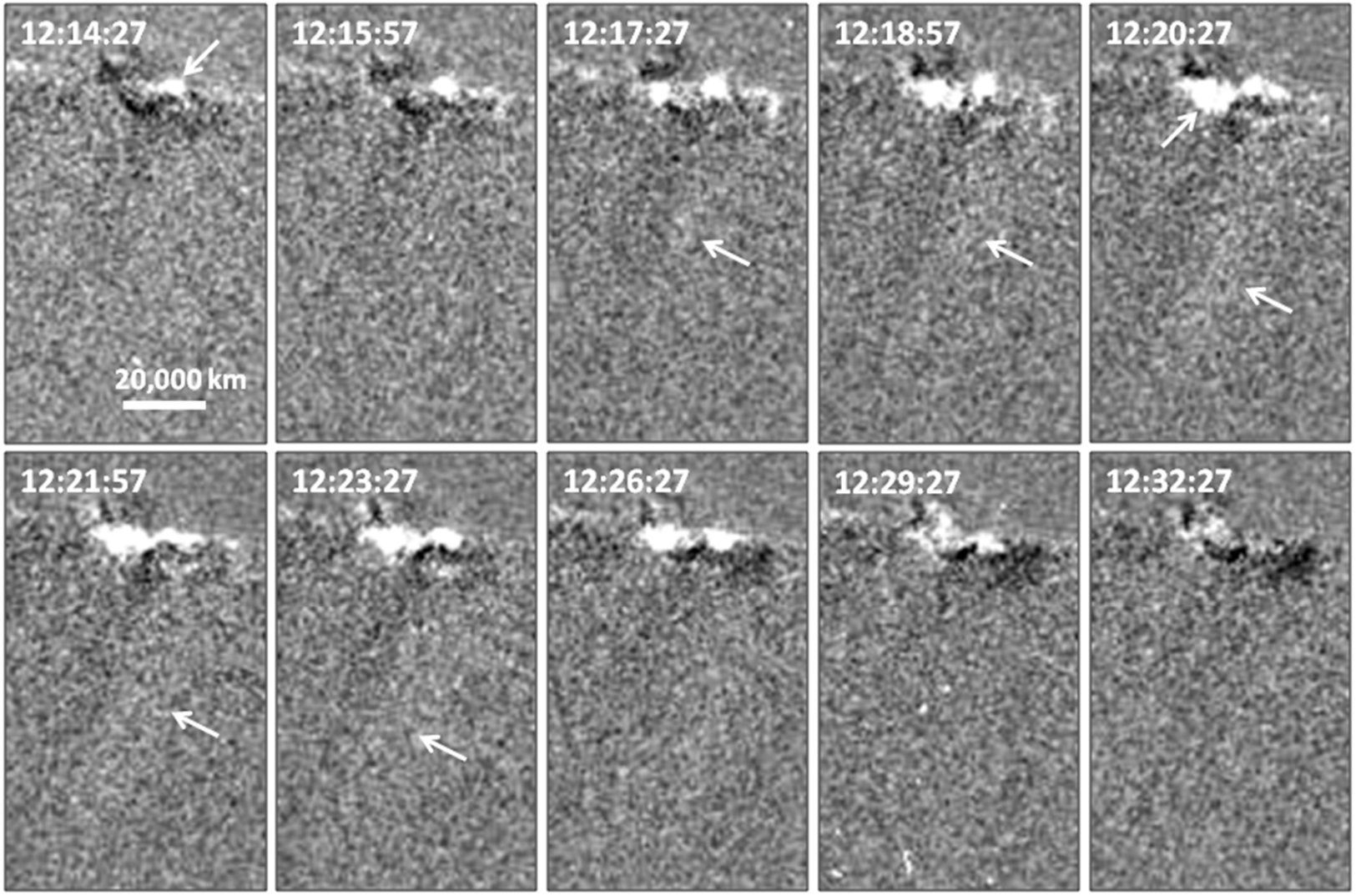
Spin of Cool Component of Example Standard X-Ray Jet

2010 Aug 28, SDO/AIA He II 304 Å



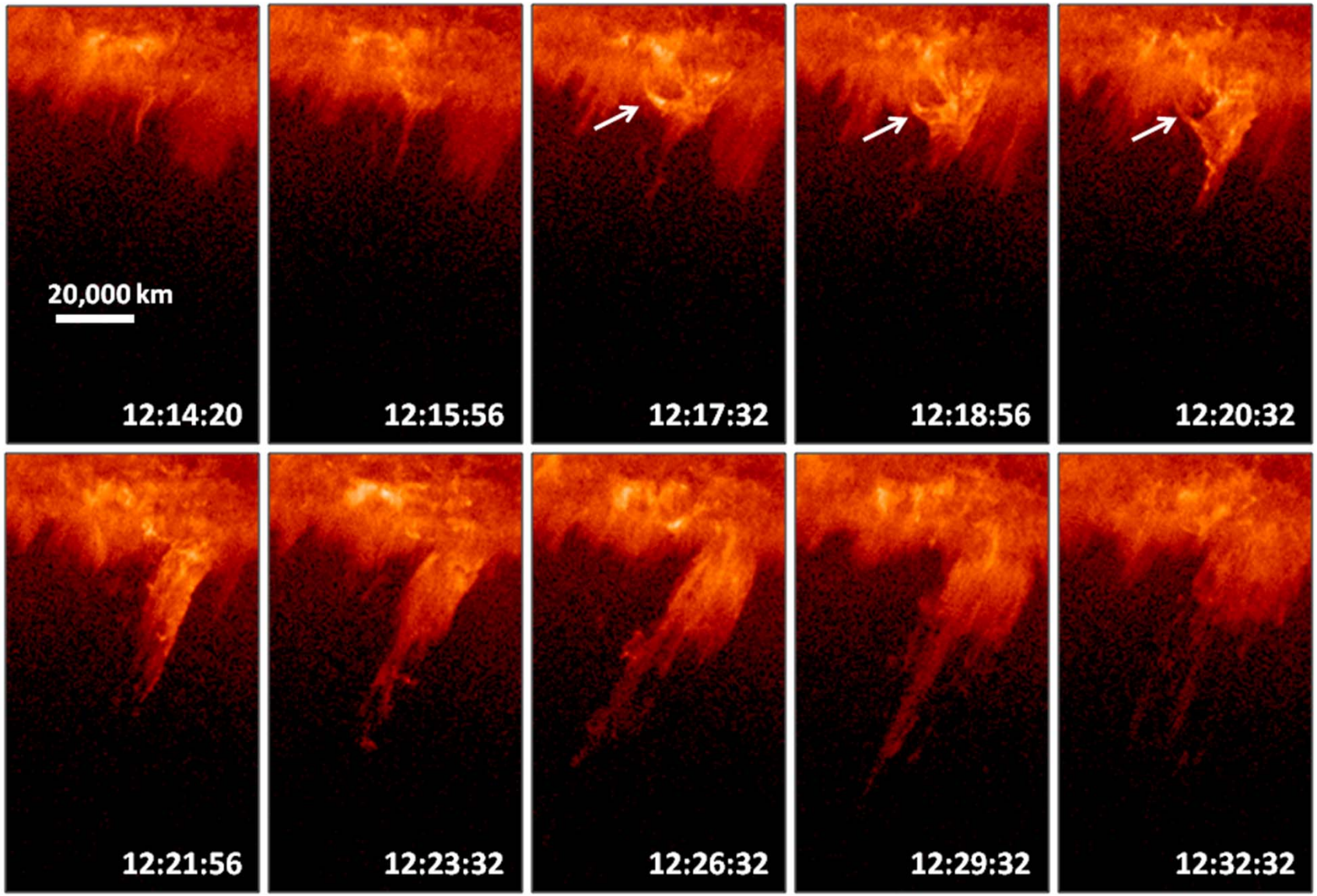
Example Blowout X-Ray Jet

2011 Mar 24, Hinode/XRT Thin Al Poly, Fixed-Difference Sequence



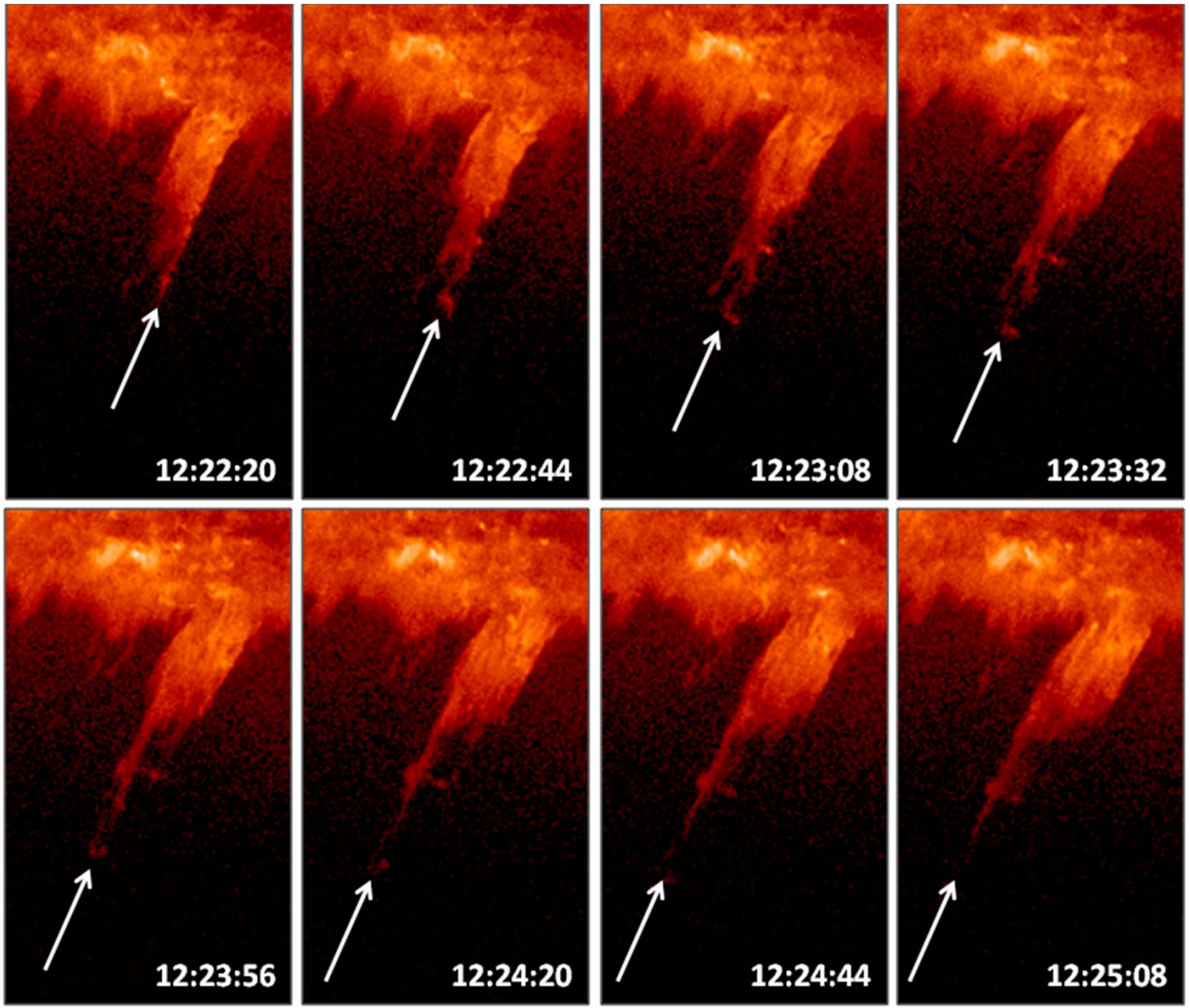
Cool Component of Example Blowout X-Ray Jet

2011 Mar 24, SDO/AIA He II 304 Å



Spin of Cool Component of Example Blowout X-Ray Jet

2011 Mar 24, SDO/AIA He II 304 Å

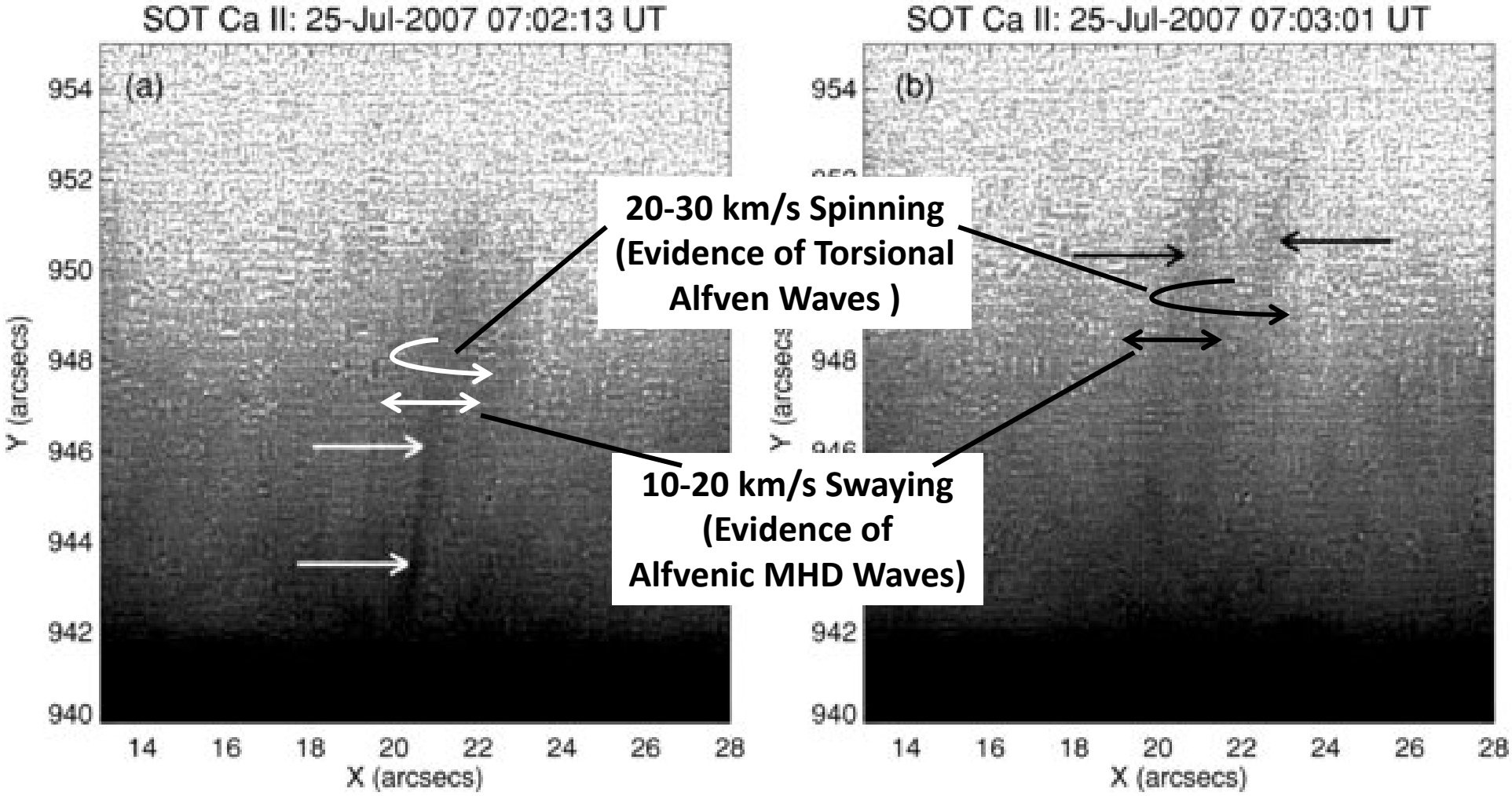


Key Observed Features of X-Ray Jets

- **Erupt from closed-bipole base.**
- **Dichotomy of sideways expansion.**
- **Spin and sway.**

Standard-Jet/Blowout-Jet Dichotomy of Type-II Spicules

(from Sterling et al 2010, ApJ,714, L6)



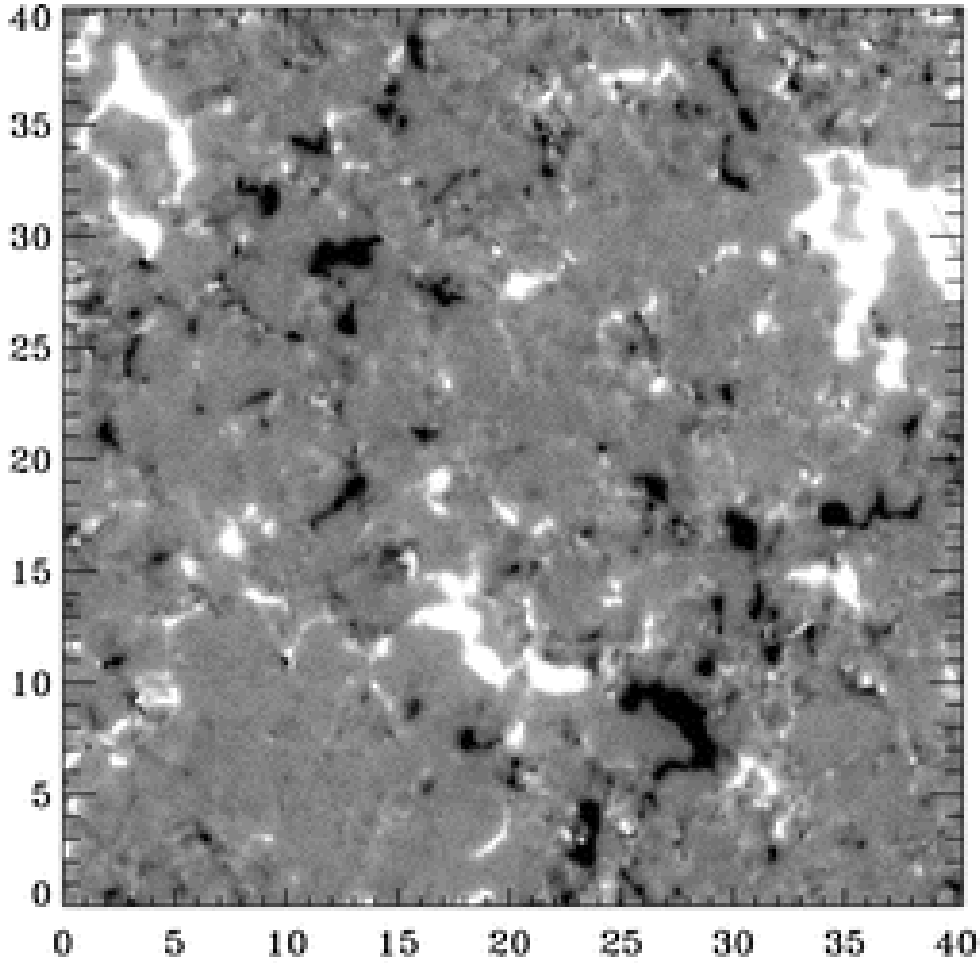
Single-Spike Type-II Spicule
(Similar to Standard X-Ray Jets)

Laterally-Expanding Type-II Spicule
(Similar to Blowout X-Ray Jets)

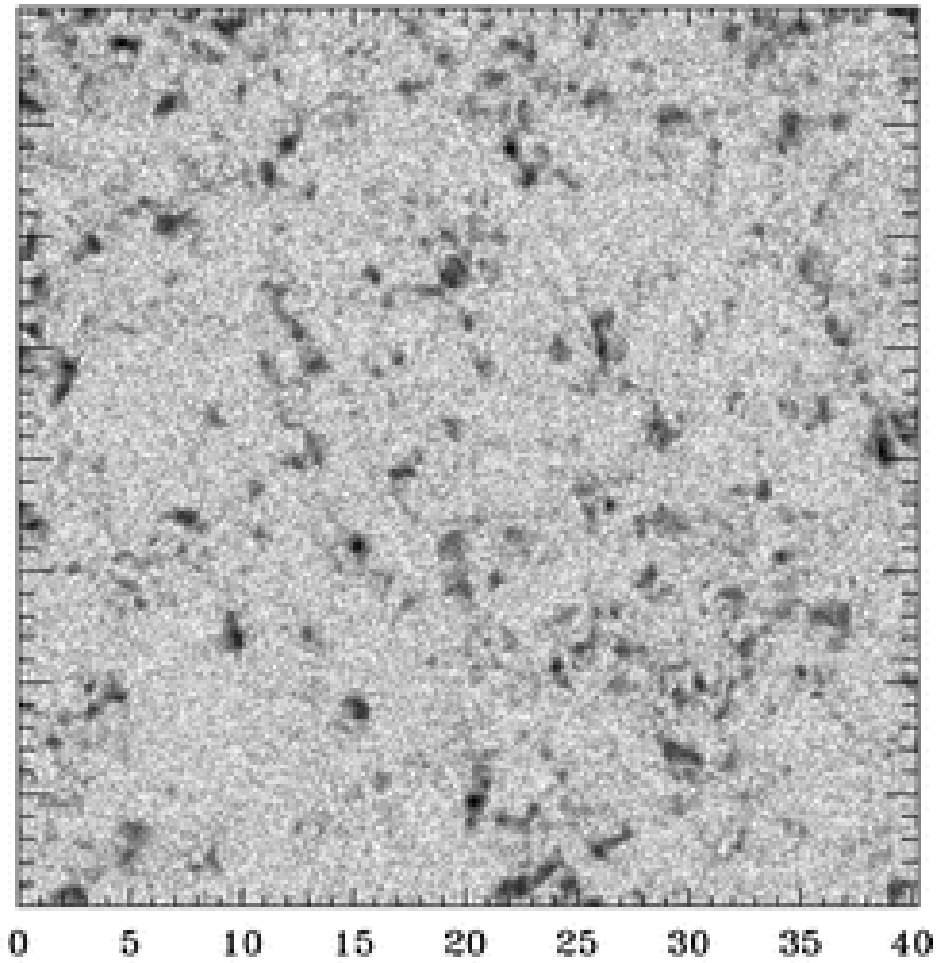
Granule-Size Emerging Magnetic Bipoles (EBs)

Population Density and Loose Proximity to Magnetic Network

(from Lites et al 2008, ApJ, 672, 1237)



Magnetic Network Vertical Field (± 50 G)

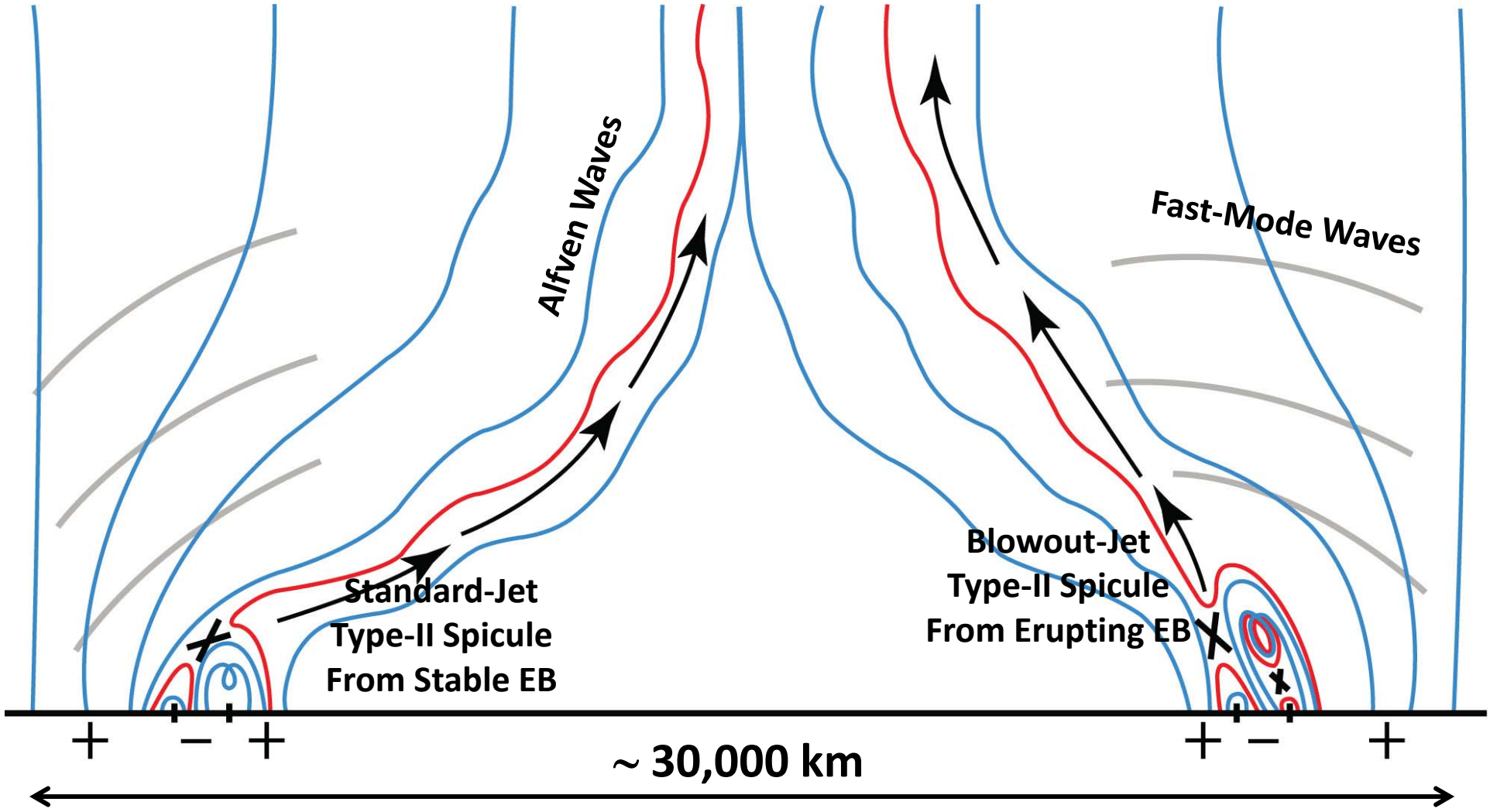


Horizontal Field in Granule-Size EBs (~100 G)

EB Population Density: ~1 per 10 granules (~100 per supergranule).
Non-Uniform Spatial Distribution: EBs are loosely clustered around the network flux.

Scenario: Emerging granule-size bipoles at feet of coronal field power corona and solar wind by generating Type-II spicules and MHD waves a la X-ray jets.

(cartoon adapted from Falconer et al 2003, ApJ, 593, 549)



Conclusion

If Type-II spicules are made like X-ray jets by granule-size emerging bipoles, then they plausibly power the quiet corona and solar wind.